Accident Analysis and Prevention 122 (2019) 8–18

Contents lists available at ScienceDirect

Accident Analysis and Prevention

journal homepage: www.elsevier.com/locate/aap

Who is responsible for global road safety? A cross-cultural comparison of Actor Maps

McIlroy R.C.[a,*], Plant K.A.[a], Hoque M.S.[b], Jianping W.[c], Kokwaro G.O.[d], Vũ N.H.[e], Stanton N.A.[a]

[a] Transportation Research Group, University of Southampton, UK
[b] Bangladesh University of Engineering and Technology, Dhaka, Bangladesh
[c] Tsinghua-Cambridge-MIT Future Transport Centre, Tsinghua University, Beijing, China
[d] Institute of Healthcare Management, Strathmore University, Nairobi, Kenya
[e] National University of Civil Engineering, Hanoi, Viet Nam

ARTICLE INFO

Keywords:
Road safety
Human Factors
Sociotechnical systems
Accimap

ABSTRACT

The traditional three 'E's approach to road safety (engineering, education, enforcement) has had, and will continue to have, a significant impact on road traffic casualty rates worldwide. Nevertheless, with rising motorisation in many countries, global fatality numbers have changed little over the past decade. Following calls for the application of sociotechnical systems thinking to the problem, we widen the road safety discussion with an additional four 'E's; economics, emergency response, enablement, and, the umbrella term for the approach taken, ergonomics. The research presents an application of Rasmussen's Risk Management Framework to the road safety systems of five distinct nations; Bangladesh, China, Kenya, the UK, and Vietnam. Following site visits, reviews of literature, and interviews with subject matter experts in each of the countries, a series of Actor Map models of the countries' road safety systems were developed. These are compared and discussed in terms of the wide variety of interconnecting organisations involved, their influences on road safety outcomes, the differences between nations, and the need to look beyond road users when designing road safety interventions.

1. Introduction

Road transport is central to economic growth and sustainable development worldwide, linking families to schools, workers to jobs, producers to consumers, communities to education and health care facilities. Its importance cannot be overstated; its development is necessarily parallel to that of any given country. Yet it comes at a great cost; in 2015, road traffic incidents claimed the lives of 1.34 million people (WHO, 2017a). Of these fatalities, 90% occurred low- and middle-income countries (LMICs), countries in which only half of the world's registered vehicles are found (WHO, 2015). Globally, it is the 10th leading cause of death; for those aged between 15 and 24 it is the leading cause of death (ibid.). Additional to the fatalities, every year the world sees 78.2 million non-fatal injuries requiring medical attention (GRSF & IHME, 2014).

The 46% increase in fatality numbers that the world has seen over the past twenty years is linked with significant increases in motorisation in the developing world (GRSF & IHME, 2014); however, an increase in road deaths need not be a necessary side effect of increased access to mobility. Between 1986 and 2016 the UK's population increased by 15% and the number of vehicle miles driven by around 50%, yet its fatality rates dropped by 68% (Department for Transport, 2016, 2017a). Similar trends can be found elsewhere, such as in Japan, the US, and Sweden (see GRSF & IHME, 2014). That said, the issue is highly complex; in the UK (a country for which historic traffic and economic data is readily available) there are clear links between economic activity and accident rates, with years of higher economic prosperity linked with higher numbers of fatalities and injuries (Department for Transport, 2017b).

Despite significant progress since the 1980s, the UK has, in recent years, seen road safety efforts plateau in their effectiveness; since 2010 there has been no significant change in the numbers of people killed or seriously injured on its roads (Department for Transport, 2017b). Globally, fatality numbers have seen a consistent rise over the past 40 years (WHO, 2015). Although some reports estimate a levelling off of death rates (WHO, 2015), Global Burden of Disease data suggests otherwise (GRSF & IHME, 2014).

To reduce the burden of road transport worldwide, and to improve matters further in the UK and other (relatively) high-performing countries, we need to look for fresh perspectives from which to view the

* Corresponding Author.
E-mail address: r.mcilroy@soton.ac.uk (R.C. McIlroy).

https://doi.org/10.1016/j.aap.2018.09.011
Received 29 June 2018; Received in revised form 12 September 2018; Accepted 13 September 2018

challenge. In this article we argue for a sociotechnical systems approach, using Jens Rasmussen's (1997) Risk Management Framework and the associated Actor Map representation tool (e.g. Svedung and Rasmussen, 2002). This approach structured our analyses of the road transport systems of five geographically dispersed as well as economically and culturally distinct nations; Bangladesh, China, Kenya, Vietnam, and the UK. We also argue for an expansion of the traditional three 'E's approach to road safety; not only should we identify interventions couched in engineering, education, and enforcement (aspects that dominated road safety research and practice in the past), but in economics, emergency response, enablement of research, and beyond.

2. The Many 'E's of Road Safety

Engineering, enforcement, and education represent the 'traditional' approaches to road safety (e.g. Lonero et al. 1994). The terms encompass a wide variety of interventions; under engineering are included vehicle technology as well as road environment design efforts; enforcement covers the development and enforcement of legal standards (in-vehicle and product design, for example) in addition to the use of law to shape driver behaviour; and education includes both the pre- and post-license training of drivers, as well as the education of the wider public. These have been critical in improving road safety outcomes in the past, and will continue to be so into the future. Nevertheless, we need to look beyond these approaches if we are to overcome the challenges faced. We must expand our repertoire of the lenses through which we view road safety. Here we put forward three additional 'E's, namely economics, emergency response, and enablement. To add to the alliteration, all of these 'E's are couched in a seventh, ergonomics; we use this as the umbrella term for the approach taken (i.e., the sociotechnical theoretical framework and methods). This is by no means an exhaustive or definitive list of potentially useful 'E's (or any other letter for that matter), rather it is a starting point for expanding discussions around road safety.

2.1. Economics

In the UK alone, the value of prevention of all reported road casualties was estimated at £15.3 billion for the year 2015; if we include unreported casualties, this estimate rises to £35.55 billion (DfT, 2016). Globally, road traffic injury and death is thought to cause economic losses of around 3% of a country's GDP; in LMICs, the figure rises to 5% of GDP (WHO, 2015). It is clearly an issue of economics; yet despite the huge financial cost, budgetary constraints often dictate just how much can be invested in road safety each year. Indeed, funding is considered the primary barrier to engineering solutions to road safety (Ciaburro and Spencer, 2017).

Where engineering (and educating) will, in the overwhelming majority of circumstances, require expenditure without any expectation of subsequent income generation, economic incentives can be used to both shape driver behaviour and generate income at the same time. In Uganda, for example, income generated through fining drivers caught speeding more than outweighed the economic cost of the police patrols required to catch offenders (Bishai et al. 2008). In the UK, cost-benefit analyses of speed cameras suggest a net financial gain for the economy when considering the benefits from avoided injuries (Gains et al., 2005), despite the assertion that the placement of speed cameras is based on safety considerations and not on financial ones (House of Commons Transport Committee, 2016).

These gains are without taking into account the cost benefits of life years saved or deaths averted, though this is a sensitive topic; not only is evidence from cost-effectiveness analyses of road traffic interventions in LMICs mixed (Banstola and Mytton, 2017), but cost benefit analyses of road safety programmes are fraught with ethical quandaries (for example how to value human life; see Viscusi and Aldi, 2003, for a well cited text on the matter). Moreover, although avoiding the costs associated with road traffic injury (e.g. health care expenditure, property damage, productivity loss) can undeniably provide economic benefit to a society, the avoidance of expenditure is not as easily traced as is countable, monetary income. As such, economic considerations rarely figure in road safety discussions.

2.2. Emergency Response

In 2015-16, £2.2 billion was spent on ambulance services in the UK, £1.78 billion of which was on urgent and emergency services (National Audit Office, 2017). In many other countries, no such services exist. The quality of emergency care available has a significant effect on the health outcomes of a particular patient, in terms of both speed of response and quality of care (e.g. Clark et al. 2013; Razzak and Kellermann, 2002; Sánchez-Mangas et al. 2010; Balikuddembe et al. 2017). Indeed, in the UK, the improvement in medical care standards was identified as the primary reason for the fall in casualty rates in the UK from road traffic incidents across the years 1978 to 1998 (Noland and Quddus, 2004). Not only was post-impact care the focus of a recent European Commission report on road safety (European Commission, 2016), but it represents a 'pillar of action' in the UN's Global Plan for the Decade of Action (on road safety; see WHO, 2017b) as well as a key strategy in the World Health Organisation's world report on road traffic injury prevention (Peden et al. 2004).

2.3. Enablement

Perhaps the least immediately obvious of the approaches to road safety thus far introduced, enablement here refers to the activities that make advances in other areas possible. Funding is, of course, part of this, but also of significant importance is the enablement of research through a cultural and societal environment that supports such work, and through the availability of reliable, high quality data to allow the research to be undertaken.

In the UK, police have recorded road traffic accident data since 1926, and have used the same form to record data from all reported incidents since 1979 (the STATS19 form, available from ADRN, 2018). Moreover, the UK is the highest ranked country in terms of the openness of government data (see opendatabaromter.org). As such, access to high quality data is rarely the greatest challenge for road safety researchers in the UK. In many LMICs the situation quite the opposite, with the majority of countries having very limited data systems. Inconsistent and incomplete data collection tools result in inconsistencies in global road safety statistics (e.g., GRSF & IHME, 2014; Al-Madani, 2018), which in turn cloud the true global road safety picture, hindering the development of successful road safety policies (Dimitriou et al. 2018).

Complex problems (such as road safety) require rich, complex data sets to guide solutions (Arzberger et al. 2004), with open access to publicly funded data providing greater returns from public investment (Janssen et al. 2012). This is particularly important for public health research, which relies on large data sets; as Walport and Brest write in The Lancet, "Ensuring data are made widely available to the research community accelerates the pace of discovery and enhances the efficiency of the research enterprise" (Walport and Brest, 2011, p.12). Indeed, that data sharing has positive results for public health and can save lives is, in the words of Pisani et al., "demonstrably true" (Pisani et al. 2016, p. 1). If one accepts that road safety is an international public health issue (a notion we consider manifest), one must accept that data openness is a central part of the path to reduced injury and fatality rates.

3. Ergonomics: A Sociotechnical Approach to Road Safety

The focus on the individual driver as the root cause of accidents, pervasive in the public and academic literature (see Dekker, 2011 and Scott-Parker et al. 2015 for discussions), is beginning to be challenged